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In re Application of:
Robert S. Lewandowski et al.

Serial No.: 10/814,956

Filed: March 31, 2004

For: METHOD AND MEANS FOR
ISOLATING ELEMENTS OF A
SENSOR ARRAY

§
§
§ Group Art Unit: 3662
§
§ Examiner: Ian J. Lobo
§
§
§ Atty. Docket: 126956-6/YOD
§ GERD:0607
§

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February 19, 2008

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Lynda Howell

APPEAL BRIEF PURSUANT TO 37 C.F.R. §§ 41.31 AND 41.37;
REPLY TO THE NOTICE OF NON-COMPLIANT APPEAL BRIEF
AND
RESPONSE TO OFFICE COMMUNICATION MAILED JULY 9, 2007

This Appeal Brief is being filed in furtherance to the Notice of Appeal mailed on January 28, 2007, and received by the Patent Office on January 29, 2007. This is also in Reply to the Notice of Non-Compliant Appeal brief mailed on May 11, 2007 and Office Communication mailed July 9, 2007.

IF NOT ALREADY CHARGED UPON FILING OF THE ORIGINAL BRIEF,
the Commissioner is authorized to charge the requisite fee of \$500.00, and any additional

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fees which may be necessary to advance prosecution of the present application, to Account No. 07-0868, Order No. 126956-6/YOD (GERD:0607).

1. **REAL PARTY IN INTEREST**

The real party in interest is General Electric Company, the Assignee of the above-referenced application by virtue of the Assignment to General Electric Company by Robert Stephen Lewandowski, Lowell Smith, Douglas Wildes, Charles Baumgartner, Rayette Ann Fisher, George Sogoian, and David Mills, recorded at reel 014620, frame 0352, and dated May 11, 2004. Accordingly, General Electric Company will be directly affected by the Board's decision in the pending appeal.

2. **RELATED APPEALS AND INTERFERENCES**

Appellants are unaware of any other appeals or interferences related to this Appeal. The undersigned is Appellants' legal representative in this Appeal.

3. **STATUS OF CLAIMS**

Claims 1-10, 12, 35-37 and 39 are currently pending, are currently under final rejection and, thus, are the subject of this Appeal. Claims 11, 18-34, 38 and 45-50 were earlier cancelled, and claims 13-17 and 40-44 stand withdrawn.

4. **STATUS OF AMENDMENTS**

There are no outstanding amendments to be considered by the Board.

5. **SUMMARY OF CLAIMED SUBJECT MATTER**

The present invention relates generally to the field of sensor arrays. *See*, Application page 1, line 4. More particularly, the present invention relates to micromachined ultrasonic transducers (MUTs).

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Acoustic energy generated using a capacitive micromachined ultrasonic transducer device does not rely on a piezoelectric material to generate ultrasonic energy. Rather, the basic structure of a cMUT cell is that of a conductive membrane or diaphragm suspended above a conductive electrode by a small gap. When a voltage is applied between the membrane and the electrode, Coulombic forces attract the membrane to the electrode. *See*, Application page 3, lines 20-25. The cMUT device is typically built with multiple membranes per transducer element. A complete transducer probe used for medical imaging, non-destructive evaluation or some other imaging device comprises multiple transducer elements arranged in a row or rows to form an array, each element comprising a plurality of cMUT cells having their electrodes electrically connected together. Each element of the array needs to act independently from its neighbors. Since the array of transducer elements is built on a common substrate, the problem exists that there will be both electrical and mechanical interference between neighboring elements (i.e., crosstalk). *See*, Application, page 3, lines 32-35 and page 4, lines 1-5.

The above discussed and other drawbacks and deficiencies of the prior art are overcome or alleviated by an array of sensors that have isolation between the transducer elements. The Application contains two independent claims, namely, claims 1 and 35, both of which are the subject of this Appeal. The subject matter of these claims is summarized below.

With regard to the aspect of the invention set forth in independent claim 1, discussions of the recited features of claim 1 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates to a sensor device (*e.g.*, 20). *See, e.g., id.* at page 9, lines 6-7. The sensor device comprises a multiplicity of sensor elements (*e.g.*, 2). *See, e.g., id.* at page 15, lines 19-20. The sensor elements arranged at a front surface of a substrate (*e.g.*, 4). *See, e.g., id.* at page 10, lines 21-22; *see also*, FIG. 1. Each of the sensor elements is in contact with material of the substrate, and a multiplicity of barriers

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(*e.g.*, 38) are arranged in the material of the substrate to reduce the coupling of a form of energy between any of the sensor elements, each barrier posing an obstacle to the propagation of the form of energy impinging thereon. The multiplicity of barriers extend into the material of the substrate but not completely through the material of the substrate. *See, e.g., id.* at page 13, lines 1-4; *see also*, FIG. 6. The barriers and adjoining portions of the substrate are coated with a thin layer of insulating material. *See, e.g., id.* at page 13, lines 22-26.

With regard to the aspect of the invention set forth in independent claim 35, discussions of the recited features of claim 35 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention relates to an ultrasonic transducer device (*e.g.*, 20). *See, e.g., id.* at page 9, lines 6-7. The ultrasonic transducer device comprises a multiplicity of ultrasonic transducer elements. *See, e.g., id.* at page 15, lines 19-20. The transducer elements are arranged at a front surface of a substrate (*e.g.*, 4). *See, e.g., id.* at page 10, lines 21-22. Each of the transducer elements comprises a respective group of ultrasonic transducer cells (*e.g.*, 2). *See, e.g., id.* at page 10, lines 1-3; *see also*, FIG. 4. The cells are electrically connected together and acoustically coupled to the substrate (*e.g.*, 4). *See, e.g., id.* at page 10, lines 21-22, *see also*, FIG. 1. The cells are also acoustically coupled to a multiplicity of trenches (*e.g.*, 26). *See, e.g., id.* at page 11, lines 6-9; *see also*, FIG. 6. The trenches are disposed in areas between the transducer elements, and the trenches obstruct the propagation of acoustic wave energy therethrough. The multiplicity of trenches extend into the material of the substrate but not completely through the material of the substrate. *See, e.g., id.* at page 13, lines 1-4; *see also*, FIG. 6. The trenches and adjoining portions of the substrate are coated with a thin layer of insulating material. *See, e.g., id.* at page 13, lines 22-26.

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A benefit of the invention, as recited in these claims, is providing a barrier between transducer elements, where each barrier poses an obstacle to the propagation of the form of energy impinging thereon. *See, e.g., id.* at page 4, lines 24-25.

6. **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

First Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's first ground of rejection in which the Examiner rejected claims 12 and 39 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Appellants regard as the invention.

Second Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's second ground of rejection in which the Examiner rejected claims 1-10, 12, 35-37 and 39 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,262,946 (hereinafter "Khuri-Yakub") in view of U.S. Patent 6,669,644 (hereinafter "Miller") and U.S. Patent 6,051,868 (hereinafter "Watanabe").

7. **ARGUMENT**

As discussed in detail below, the Examiner has improperly rejected the pending claims. Further, the Examiner has misapplied long-standing and binding legal precedents and principles in rejecting the claims under Sections 112 and 103. Accordingly, Appellants respectfully request full and favorable consideration by the Board, as Appellants strongly believe that claims 1-10, 12, 35-37 and 39 are in condition for allowance.

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A. **Ground of Rejection No. 1:**

The Examiner rejected claim 1 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Appellants regard as the invention.

The Examiner's focus during examination of claims for compliance with the requirement for definiteness of 35 U.S.C. 112, second paragraph, is whether the claim meets the threshold requirements of clarity and precision, not whether more suitable language or modes of expression are available. *See* M.P.E.P. § 2173.02. Although the Examiner may take exception to the terms used in the claims, the patentee may be his own lexicographer. *Ellipse Corp. v. Ford Motor Co.*, 171 U.S.P.Q. 513 (7th Cir. 1971), *aff'd*, 613 F.2d 775 (7th Cir. 1979), *cert. denied*, 446 U.S. 939 (1980). The Examiner is also reminded not to equate breadth of a claim with indefiniteness. *In re Miller*, 441 F.2d 689, 169 U.S.P.Q. 597 (CCPA 1971).

The essential inquiry pertaining to the definiteness requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. *See* M.P.E.P. § 2173.02. As set forth in Section 2173 of the Manual of Patent Examining Procedure, definiteness of claim language must be analyzed, not in a vacuum, but in light of:

- (A) The content of the particular application disclosure;
- (B) The teachings of the prior art; and
- (C) The claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made.

In reviewing a claim for compliance with 35 U.S.C. 112, second paragraph, the Examiner must consider the claim as a whole to determine whether the claim apprises one of ordinary skill in the art of its scope and, therefore, serves the notice function required by 35 U.S.C. 112, second paragraph, by providing clear warning to others as to what constitutes infringement of the patent. *See Solomon v. Kimberly-Clark Corp.*, 216

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F.3d 1372, 1379, 55 U.S.P.Q.2d 1279, 1283 (Fed. Cir. 2000). Only when a claim remains insolubly ambiguous without a discernible meaning after all reasonable attempts at construction must a court declare it indefinite. *See Metabolite Labs., Inc. v. Lab. Corp. of Am. Holdings*, 370 F.3d 1354, 1366, 71 U.S.P.Q.2d 1081, 1089 (Fed. Cir. 2004). Accordingly, a claim term that is not used or defined in the specification is not indefinite if the meaning of the claim term is discernible. *See Bancorp Services, L.L.C. v. Hartford Life Ins. Co.*, 359 F.3d 1367, 1372, 69 U.S.P.Q.2d 1996, 1999-2000 (Fed. Cir. 2004).

First, Appellants submit that the terminology “electrically conductive material that is grounded to electrically isolate one sensor element from the next” recited in claims 12 and 39 sets out and circumscribes the claimed subject matter with a reasonable degree of clarity and particularity. In fact, it appears that the Examiner is confusing claim breadth with indefiniteness. The element of “electrically conductive material that is grounded to electrically isolate one sensor element from the next” is explained in detail on page 15, paragraph 2, lines 6-16 of the application:

Alternatively, a primarily non-conductive substrate could be used for cMUT fabrication where the bottom electrode would be either deposited metal or selectively doped regions under the cMUT. In this case, it may be desirable to ground the regions between each element by selectively doping these regions and electrically grounding them. Another method of grounding the regions between elements that are separated with isolation trenches (as previously described) would be to coat a surface (e.g., the walls) of the trenches with an electrically conductive material, such as aluminum or an aluminum-silicon alloy, and then connect this metal to ground to electrically isolate one element from the next. Either method would allow stray charges to be conducted to ground rather than to neighboring elements.

In view of the original application, including the passage cited above, the recitation “electrically conductive material that is grounded to electrically isolate one sensor element from the next” can be readily identified and understood by one of ordinary skill in the art. Thus, the “electrically conductive material that is grounded to

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electrically isolate one sensor element from the next” is not indefinite as suggested by the Examiner.

Secondly, Appellants submit that in view of the original application, including the passage cited above, recitation of the element “electrically conductive material that is grounded to electrically isolate one sensor element from the next” in claims 12 and 39 does further limit the subject matter of claims 1 and 35, respectively, and more specifically, does not appear to contradict the independent claims as suggested by the Examiner.

For these reasons among others, the Appellants respectfully request withdrawal of the foregoing rejections under 35 U.S.C. § 112, second paragraph.

B. Ground of Rejection No. 2:

The Examiner rejected claim 11 under 35 U.S.C. § 103(a) as being unpatentable over Khuri-Yakub in view of Miller and Watanabe.

1. Judicial precedent has clearly established a legal standard for a *prima facie* obviousness rejection.

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (B.P.A.I. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes all of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). When prior art references require a

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selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988).

2. **The Examiner's rejection of independent claim 11 is improper because the rejection fails to establish a *prima facie* case of obviousness.**

Independent claim 1 recites:

A sensor device comprising:
a multiplicity of sensor elements arranged at a front surface of a substrate, each of said sensor elements being in contact with material of said substrate; and
a multiplicity of barriers arranged in said material of said substrate to reduce the coupling of a form of energy between any of said sensor elements, each barrier posing an obstacle to the propagation of said form of energy impinging thereon, wherein the multiplicity of barriers extend into said material of said substrate but not completely through said material of said substrate, and wherein said barriers and adjoining portions of said substrate are coated with a thin layer of insulating material.

Independent claim 35 recites:

An ultrasonic transducer device comprising:
a multiplicity of ultrasonic transducer elements arranged at a front surface of a substrate, each of said transducer elements comprising a respective group of ultrasonic transducer cells electrically connected together and acoustically coupled to said substrate; and
a multiplicity of trenches in said material of said substrate, said trenches being disposed in areas between said transducer elements, and said trenches obstructing the propagation of acoustic wave energy therethrough, wherein the multiplicity of trenches extend into said material of said substrate but not completely through said material of said substrate, and wherein said trenches and adjoining portions of

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said substrate are coated with a thin layer of insulating material.

a. **Features of Independent Claims 1 and 35 Omitted from Cited References**

The Examiner relied upon Khuri-Yakub to teach the claimed sensor device, including a multiplicity of sensor elements arranged on the front surface of a substrate. Additionally, the Examiner relied upon Khuri-Yakub to teach a barrier arranged in the substrate material to reduce the coupling of a form of energy between any of the sensor elements. Further, the Examiner acknowledged that Khuri-Yakub does not teach or suggest a multiplicity of barriers. The Examiner relied upon Miller to teach a sensor device where a plurality of sensor elements are arranged on a substrate, where the substrate has a plurality of barriers or trenches for reducing coupling energy between sensor elements. The Examiner further argued that Miller is believed to teach a sensor device where a plurality of sensor elements are arranged on a substrate. The substrate has a plurality of barriers or trenches for reducing coupling energy between sensor elements.

Appellants respectfully submit that the claims require that *barriers or trenches do not extend completely through the substrate material*. As described in the present application, each of the barriers or trenches starts at the front surface of the substrate and has a depth less than a thickness of the substrate as depicted in the embodiment illustrated in FIG. 6. Support for this interpretation may be found at least in a passage at lines 6-16 of page 11 of the application. Moreover, in the embodiment illustrated in FIG. 8 of the application, each of the barriers and trenches starts at a rear surface of the substrate and has a depth less than a thickness of the substrate. Further support for this aspect of the claimed arrangement may be found at least in a passage at lines 5-11 of page 13 of the application.

In contrast, as depicted in FIGS. 2-5 of Miller, a plurality of holes (215, 315, 415, 515) are etched through the MUT substrate 220 proximate to each MUT cell 216. In

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particular, each via 215 is etched *completely through* the MUT substrate 220, thereby creating voids in the MUT substrate 220, as discussed, *inter alia*, in a passage at col. 3, lines 36-46 of Miller. Additionally, Appellants also wish to bring to the Board's attention that Miller teaches doping each of the vias 215 to be electrically conductive. Each of the electrically conductive vias 215 is then employed to electrically connect a MUT element 210 to associated circuitry, as discussed, *inter alia*, at col. 3, lines 49-58 of Miller.

It is merely an assumption on the Examiner's part that the vias of Miller are functional equivalents of the barriers claimed. The vias as suggested in Miller, are conductive holes, which are employed to electrically connect MUT elements. In contrast, as recited in a passage at page 4, lines 22-25 of the present application, the claimed barriers in the barriers and trenches of the present application are employed to obstruct the propagation of the energy.

Furthermore, in contrast to the conductive vias of Miller, each of the claimed barriers and trenches and adjoining portions of the substrate may be coated with a thin layer of insulating material, as discussed, *inter alia*, in the passage at lines 1-7 of page 14 of the application.

Accordingly, Miller teaches a plurality of holes (vias 215) that are etched completely through the MUT substrate 220, while the present claims relate to structures in which barriers or trenches are formed such that *each of the barriers or trenches starts at the front surface or the back surface of the substrate and has a depth less than a thickness of the substrate*. Additionally, each of the barriers or trenches is coated with an insulating material. In other words, Appellants respectfully submit that there is simply no similarity between the vias 215, 315, 415, 515 of Miller and the multiplicity of barriers recited in the claims. For at least this reason, the hypothetical combination of references fails to read on all the features of the claimed invention.

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b. Watanabe may not be fairly combined with Khuri-Yakub

First, as noted above, Miller teaches vias that extend *completely through* the substrate. This is clearly exactly what claims 1 and 35 exclude. Accordingly, Appellants contend that Miller either cannot possibly support a *prima facie* case of obviousness, or at the very least, that the proposed combination would be antithetical to Miller's clear teachings.

Moreover, the Examiner relied on Watanabe solely for its disclosure of a semiconductor device wherein trenches are also coated with silicon oxide or silicon nitride (insulators) for reducing cross talk. Appellants respectfully observe that Watanabe relates to a semiconductor device, and more particularly relates to a semiconductor device comprising a high-speed analog circuits connecting to multiple-power supplies and specific structures capable of reducing cross talk originating in these analog circuits. Specifically, Watanabe discloses a principle of operation wherein electric potentials of high concentration n-type layers are stabilized at a fixed value by supply of power through electrodes mounted on the these layers in order to prevent cross talk.

In a complete contrast, Khuri-Yakub relates to capacitive micromachined ultrasonic transducers to minimize the excitation and propagation of plate waves and ultrasonic waves.

Moreover, Watanabe discloses the use of trenches to reduce cross-talking only in context of *separating transistors* unlike in context of *separating transducer arrays* as disclosed by Khuri-Yakub. Appellants respectfully submit that it would be improper to modify the transducer-based system of Khuri-Yakub to include trenches as disclosed by Watanabe, because such a modification would change the principle of operation of Khuri-Yakub. In fact, it would require a substantial redesign of Khuri-Yakub to

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incorporate trenches, and it would render the transducer-based system of Khuri-Yakub inoperable for its intended purpose.

For the foregoing reasons, Appellants respectfully submit that Khuri-Yakub and Watanabe teach contrastingly different intended purposes and principles of operation, which would change if the cited references were hypothetically combined as suggested by the Examiner. As summarized above, a proposed modification or combination of references is entirely improper and insufficient to support a *prima facie* case of obviousness, where the proposed modification or combination would change the principle of operation of the cited reference or render the cited reference unsatisfactory for its intended purpose. For at least these reasons, the hypothetical combination of Khuri-Yakub and Watanabe is improper and cannot be made. Accordingly, Appellants respectfully request withdrawal of the foregoing rejections and allowance of the corresponding claims.

In addition, the Examiner has not shown the requisite motivation or suggestion to modify or combine the cited references to reach the present claims. The Examiner must provide objective evidence, rather than subjective belief and unknown authority, of the requisite motivation or suggestion to combine or modify the cited references. In *re Lee*, 61 U.S.P.Q.2d. 1430 (Fed. Cir. 2002). In the present rejection, the Examiner combined the cited references based on the *conclusory and subjective statement* that it would have been obvious "to one of ordinary skill in the art to include a multiplicity of barriers between the sensor elements (2) so as to provide for greater reduction of cross-coupling between the multiplicity of sensor elements." Office Action, page 3, lines 15-18. Accordingly, Appellants respectfully request the Board to reverse the rejection on at least this basis.

Further, the claims depending directly or indirectly from independent claims 1 and 35 are allowable by virtue of their dependency from an allowable base claim, as well

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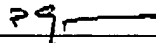
as for the subject matter they separately recite. Thus, it is respectfully requested that the rejection of the claims under 35 U.S.C 103(a) be reversed.

Conclusion

Appellants respectfully submit that all pending claims are in condition for allowance. However, if the Examiner or Board wishes to resolve any other issues by way of a telephone conference, the Examiner or Board is kindly invited to contact the undersigned attorney at the telephone number indicated below.

Respectfully submitted,

Date: February 19, 2008



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8. **APPENDIX OF CLAIMS ON APPEAL**

Listing of Claims:

1. A sensor device comprising:
a multiplicity of sensor elements arranged at a front surface of a substrate, each of said sensor elements being in contact with material of said substrate; and
a multiplicity of barriers arranged in said material of said substrate to reduce the coupling of a form of energy between any of said sensor elements, each barrier posing an obstacle to the propagation of said form of energy impinging thereon, wherein the multiplicity of barriers extend into said material of said substrate but not completely through said material of said substrate, and wherein said barriers and adjoining portions of said substrate are coated with a thin layer of insulating material.
2. The device as recited in claim 1, wherein said barriers are located in areas between neighboring sensor elements.
3. The device as recited in claim 1, wherein said sensor elements are arranged in a row with spacing between neighboring sensor elements, and said barriers are interleaved with said sensor elements, each pair of neighboring sensor elements having a respective barrier therebetween.
4. The device as recited in claim 1, wherein said sensor elements are arranged in a two-dimensional array with spacing between neighboring sensor elements, and said barriers form an interconnected network that defines a multiplicity of bounded areas, each bounded area being occupied by a respective sensor element.

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5. The device as recited in claim 1, wherein each of said sensor elements comprises a respective multiplicity of ultrasonic transducer cells electrically connected together.
6. The device as recited in claim 1, wherein each of said barriers comprises a respective trench.
7. The device as recited in claim 6, wherein each of said trenches starts at said front surface of said substrate and has a depth less than a thickness of said substrate.
8. The device as recited in claim 6, wherein each of said trenches starts at a rear surface of said substrate and has a depth less than a thickness of said substrate.
9. The device as recited in claim 6, wherein each of said sensor elements comprises a respective ultrasonic transducer element, and said trenches are filled with acoustically attenuative material.
10. The device as recited in claim 6, wherein each of said sensor elements comprises a respective ultrasonic transducer element, further comprising a body of acoustically attenuative material that supports said substrate.
12. The device as recited in claim 6, wherein a surface of each of said trenches is coated with an electrically conductive material that is grounded to electrically isolate one sensor element from the next.
35. An ultrasonic transducer device comprising:
a multiplicity of ultrasonic transducer elements arranged at a front surface of a substrate, each of said transducer elements comprising a respective group of ultrasonic

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transducer cells electrically connected together and acoustically coupled to said substrate;
and

a multiplicity of trenches in said material of said substrate, said trenches being disposed in areas between said transducer elements, and said trenches obstructing the propagation of acoustic wave energy therethrough, wherein the multiplicity of trenches extend into said material of said substrate but not completely through said material of said substrate, and wherein said trenches and adjoining portions of said substrate are coated with a thin layer of insulating material.

36. The device as recited in claim 35, wherein said trenches are filled with acoustically attenuative material.

37. The device as recited in claim 35, further comprising a body of acoustically attenuative material acoustically coupled to a rear face of said substrate.

39. The device as recited in claim 35, wherein a surface of each of said trenches is coated with an electrically conductive material that is grounded to electrically isolate one transducer element from the next.

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9. **EVIDENCE APPENDIX**

None.

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10. **RELATED PROCEEDINGS APPENDIX**

None.